

Claims

What is claimed is:

1. A silica optical waveguide comprising:
  - a core region having a first refractive index profile by virtue of comprising a first mixture of isotopes of silicon and oxygen; and
  - a cladding region having a second refractive index profile by virtue of comprising a second mixture of isotopes of silicon and oxygen, wherein the first and second mixtures include different isotopic concentrations of silicon and oxygen.
2. The silica optical waveguide of claim 1, wherein:
  - the refractive index throughout the core region is substantially uniform;
  - the refractive index throughout the cladding region is substantially uniform;
  - and
  - the refractive index of the core region is greater than the refractive index of the cladding region.
3. The silica optical waveguide of claim 2, wherein the cladding region consists of natural abundance silica.
4. The silica optical waveguide of claim 2, wherein the core region is enriched for  $^{30}\text{Si}$  or  $^{29}\text{Si}$ .
5. The silica optical waveguide of claim 2, wherein the core region is enriched for  $^{18}\text{O}$ .

- 1 6. The silica optical waveguide of claim 2, wherein the core region is further doped  
2 with germania.  
3
- 4 7. The silica optical waveguide of claim 2, wherein the cladding region is further  
5 doped with fluorine.  
6
- 7 8. The silica optical waveguide of claim 2, wherein the core region is further doped  
8 with erbium, ytterbium, or a combination thereof.  
9
- 10 9. A wavelength-division multiplexed optical communication system comprising the  
11 silica optical waveguide of claim 1.  
12
- 13 10. A time-division multiplexed optical communication system comprising the silica  
14 optical waveguide of claim 1.  
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- 16 11. A soliton optical communication system comprising the silica optical waveguide  
17 of claim 1.  
18
- 19 12. A Raman optical amplification system comprising the silica optical waveguide of  
20 claim 1.  
21
- 22 13. The silica optical waveguide of claim 1, wherein:  
23 the refractive index throughout the core region is substantially uniform;  
24 the refractive index of the cladding region is non-uniform; and  
25 the refractive index of the core region is greater than the highest refractive  
26 index of the cladding region.  
27
- 28 14. The silica optical waveguide of claim 13, wherein the refractive index of the

- 1 cladding region decreases smoothly and monotonically with increasing distance  
2 from the boundary of the core region and the cladding region.  
3
- 4 15. The silica optical waveguide of claim 14, wherein the refractive index of the  
5 cladding region decreases parabolically with increasing distance from the  
6 boundary of the core region and the cladding region.  
7
- 8 16. The silica optical waveguide of claim 14, wherein the refractive index of the  
9 cladding region decreases linearly with increasing distance from the boundary of  
10 the core region and the cladding region.  
11
- 12 17. The silica optical waveguide of claim 14, wherein the refractive index of the  
13 cladding region decreases in a series of  $n$  steps with increasing distance from the  
14 boundary of the core region and the cladding region, and  $n$  is an integer between 1  
15 and 100.  
16
- 17 18. The silica optical waveguide of claim 13, wherein the concentration of  $^{30}\text{Si}$  or  $^{29}\text{Si}$   
18 decreases from the boundary of the core region and the cladding region to the  
19 outer edge of the cladding region.  
20
- 21 19. The silica optical waveguide of claim 13, wherein the concentration of  $^{18}\text{O}$   
22 decreases from the boundary of the core region and the cladding region to the  
23 outer edge of the cladding region.  
24
- 25 20. The silica optical waveguide of claim 13, wherein the cladding region is further  
26 doped with germania, and the concentration of germania decreases from the  
27 boundary of the core region and the cladding region to the outer edge of the  
28 cladding region.

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2 21. The silica optical waveguide of claim 13, wherein the cladding region is further  
3 doped with fluorine, and the concentration of fluorine increases from the  
4 boundary of the core region and the cladding region to the outer edge of the  
5 cladding region.

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7 22. An optical waveguide comprising:  
8 a core region having a first refractive index profile by virtue of comprising a  
9 first mixture of isotopes of at least one element; and  
10 a cladding region having a second refractive index profile by virtue of  
11 comprising a second mixture of isotopes of said at least one element.

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13 23. The optical waveguide of claim 22, wherein said at least one element comprises  
14 gallium, arsenic, or a combination thereof.

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16 24. The optical waveguide of claim 23, wherein the core region is further doped with  
17 germania.

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19 25. The optical waveguide of claim 24, wherein the cladding region is further doped  
20 with fluorine.